

Status report:
SDSS-II/SNe properties as a function of
the distance to their host galaxies

Lluís Galbany (IFAE Barcelona)

Motivation

- Recent studies of SNe properties depending on global characteristics of the hosts (Hubert, Mat...)
- Study SNe properties as a function of **LOCAL** characteristics (star-formation rate, metallicity...) of the hosts using the distance to the center of the galaxy as a proxy
- Correlate MLCS & SALT2 SNe parameters (Δ , A_V , x_I , c ...) and Hubble residuals with distance to the host center
- Analyze different Hubble diagrams selecting sets depending on distance

Sample Selection

Cuts applied in SNANA and in the code

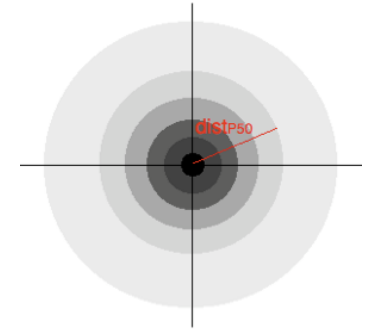
SDSS-II/SNe (SMP200Xv7 @sdssdp62)

SNe classes	2005	2006	2007	all
[105] Ia photometric id + hostgal specZ	157	98	46	301
[106] nonIa photometric id + hostgal specZ	122	102	103	327
[111] SDSS-confirmed Ib	3	2	5	10
[112] SDSS-confirmed Ic	4	6	2	12
[113] SDSS-confirmed II	10	16	38	64
[115] externally-confirmed Ib	-	-	1	1
[117] externally-confirmed II	1	-	-	1
[118] externally-confirmed Ia	1	5	3	9
[119] likely confirmed Ia	16	12	8	36
[120] SDSS-confirmed Ia	129	198	183	510
total	443	439	389	1271
SNe-Ia used for the analysis				
[105]+[118]+[119]+[120] Ia	303	313	240	856

Before SNANA cuts	856	
MLCS cuts	SALT2 cuts	
5 obs. in $-20 < t < 60$	5 obs. in $-20 < t < 60$	
1 obs. in $t < -2d$	1 obs. in $t < t_{max}$	
1 obs. in $t > 10d$	1 obs. in $t > 9.5d$	
1 ep. $S/N > 5$ in <i>gri</i>	1 ep. $S/N > 5$ in <i>gri</i>	
After SNANA cuts	598	556
	SNe after cuts	
Code cuts	MLCS	SALT2
SNANA fit $\chi^2/N_{dof} < 3$ fit	575	556
Host assigned in SNANA file	575	550
Host assigned is not a STAR	563	548
PETRO50 in SDSS-DR7	561	546
Same ANG and PHO assigned	513	498
Large Projected GCD ($< 50kpc$)	511	496
Large Normalized GCD (< 10)	479	463
$z < 0.21$	194	183
Spirals	125	116
Ellipticals	69	67
[105] Ia photo id + hostgal specZ	45	44
[118] externally-confirmed Ia	2	2
[119] likely confirmed Ia	7	3
[120] SDSS-confirmed Ia	139	133

Distance normalization

- 3 distance normalization methods (r band):
 - Petrosian radius 50: radius of a circle that contains 50% of the flux
 - Sersic profile: distance to the center of the isophotal ellipse containing half the luminosity
 - de Vaucouleurs profile (n=4) used for ellipticals
 - exponential profile (n=1) used for spirals

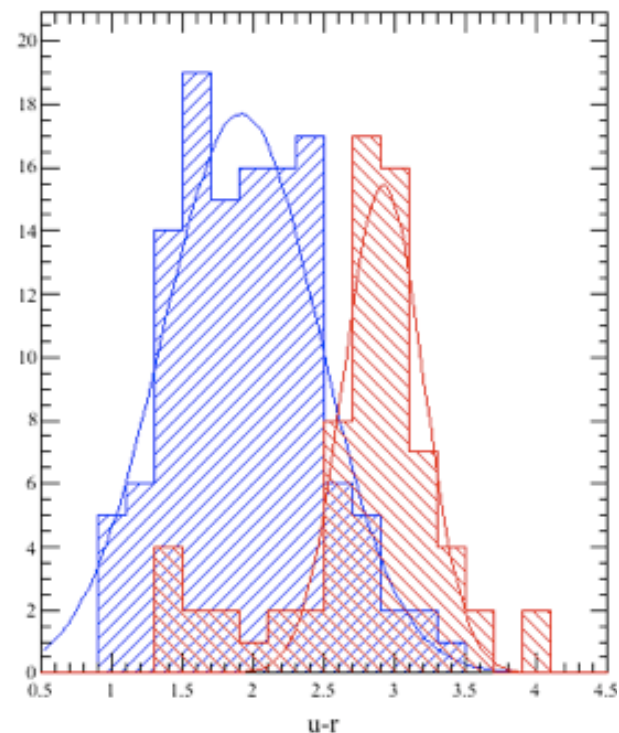
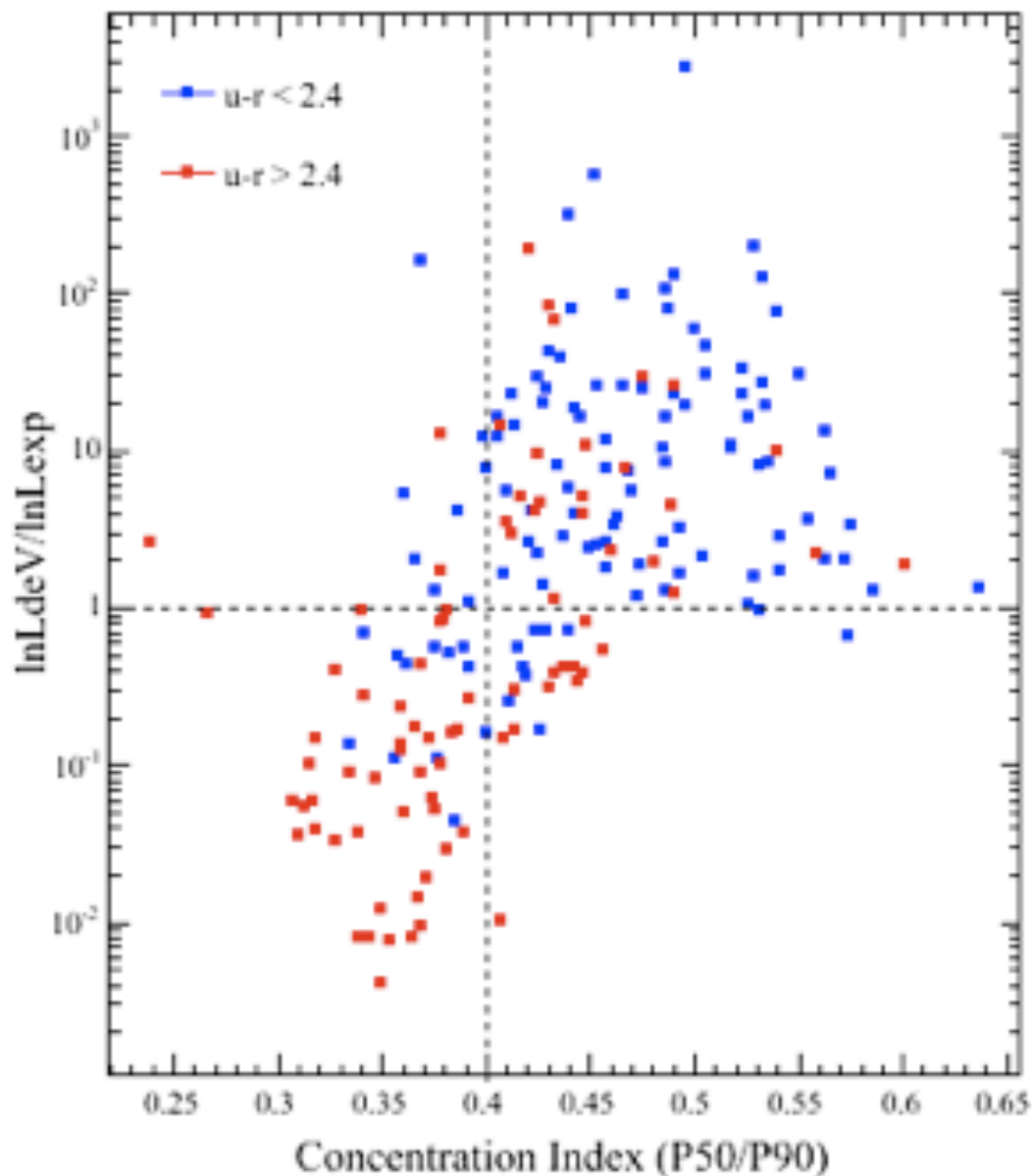


$$I(r) = I_0 \exp \left[-a (r/r_e)^{1/n} \right]$$

$$I(r) = I_0 \exp \left[-7.67 (r/r_e)^{1/4} \right]$$

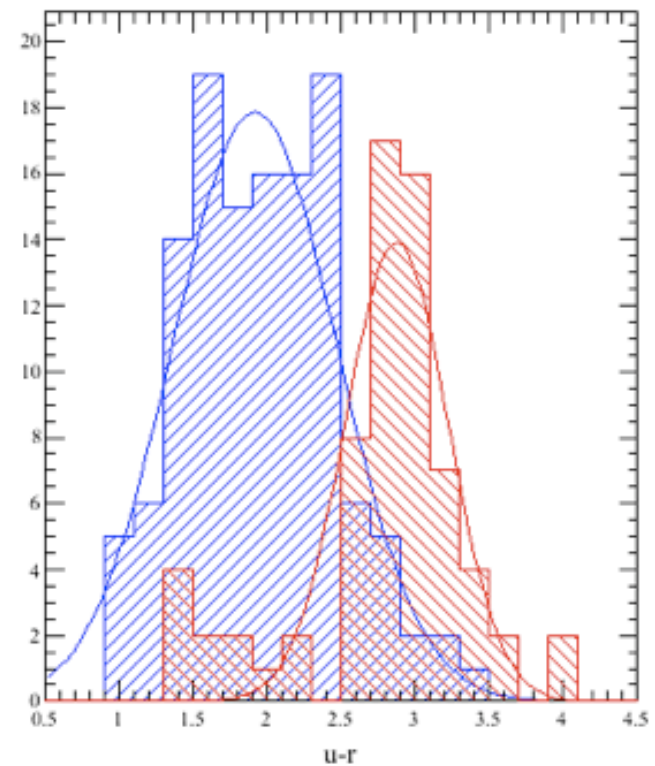
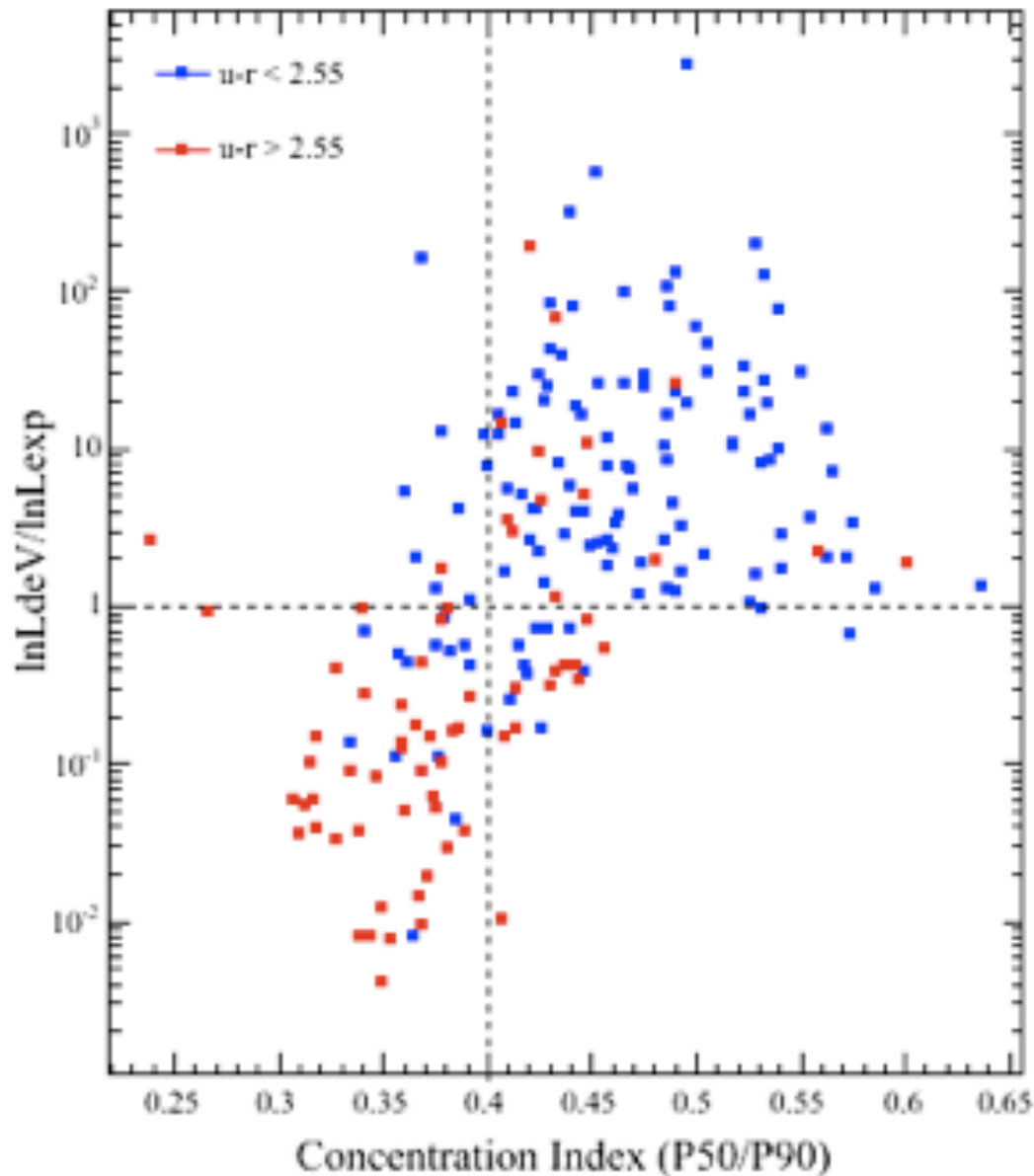
$$I(r) = I_0 \exp \left[-1.68 (r/r_e) \right]$$

Host typing



- 3 methods used in order to separate the hosts in elliptical and spiral
- color index ($u-r$)
- Inverse concentration index (Petro50/Petro90)
- Likelihood fit ($\ln L_{deV} / \ln L_{exp}$)
- Typing done by majority rule

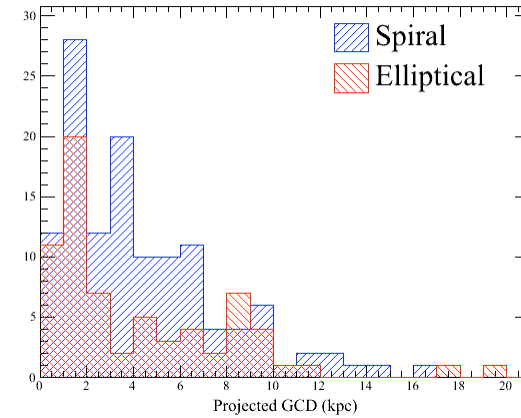
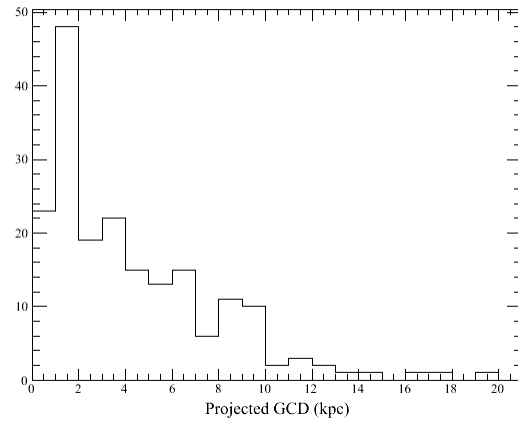
Host typing (2.55)



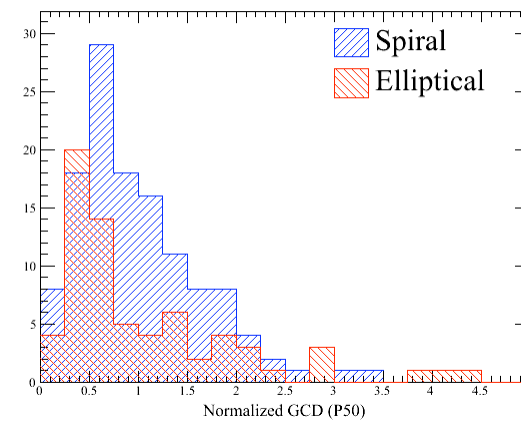
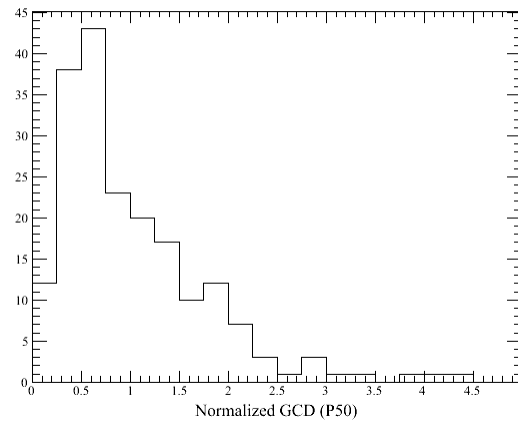
- Strateva et al. (2001) $u-r=2.22$
- Dilday et al. (2008) $u-r=2.4$
- Our best is $u-r=2.55$

MLCS GCD distributions

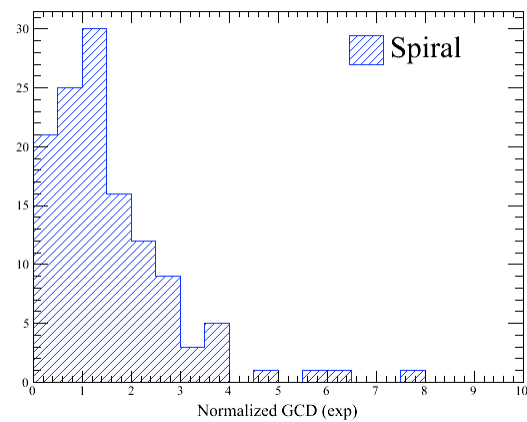
kpc



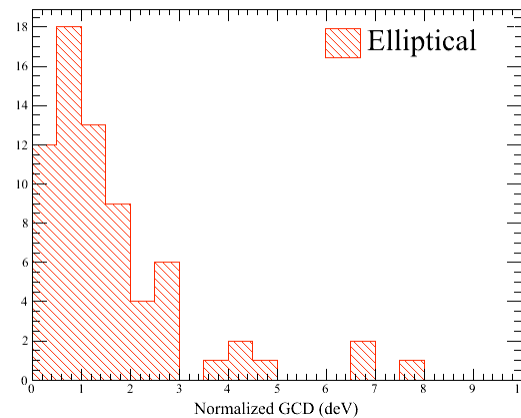
P50



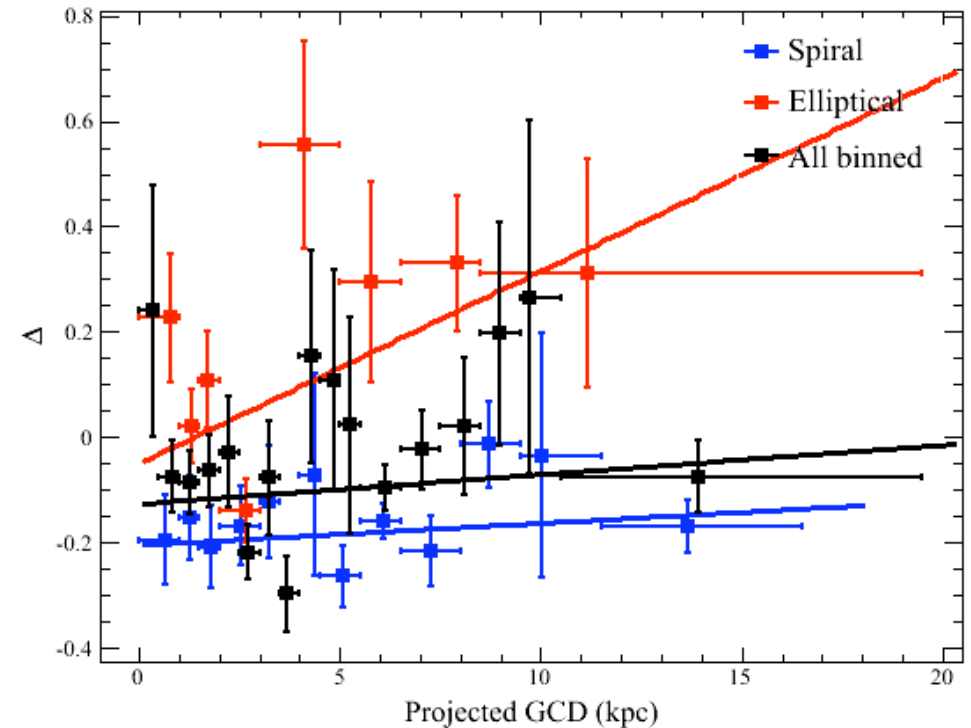
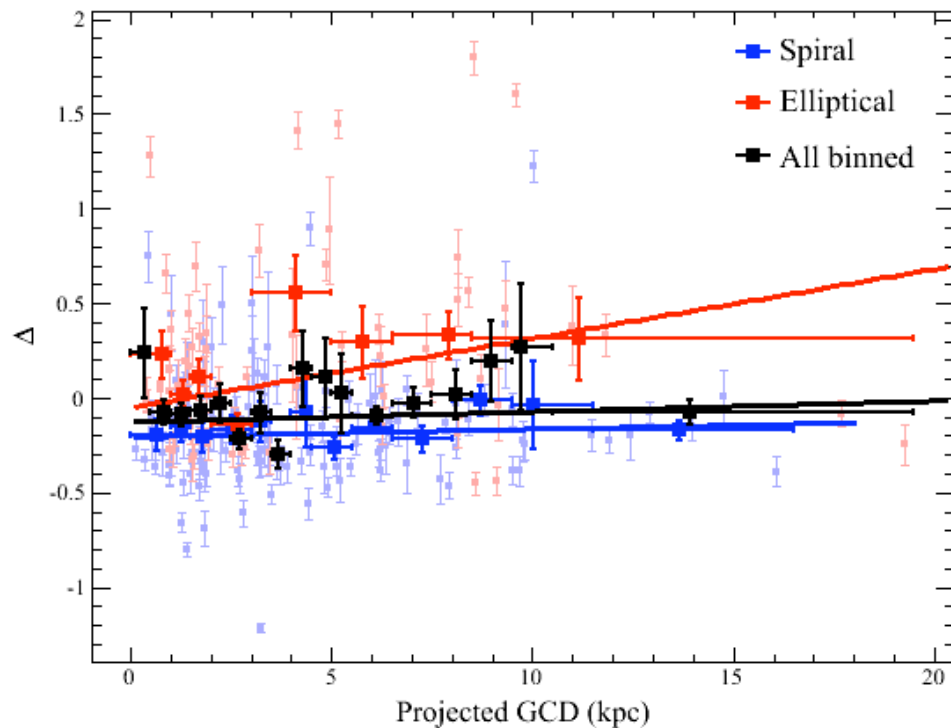
exp



deV



MLCS SN properties vs. GCD



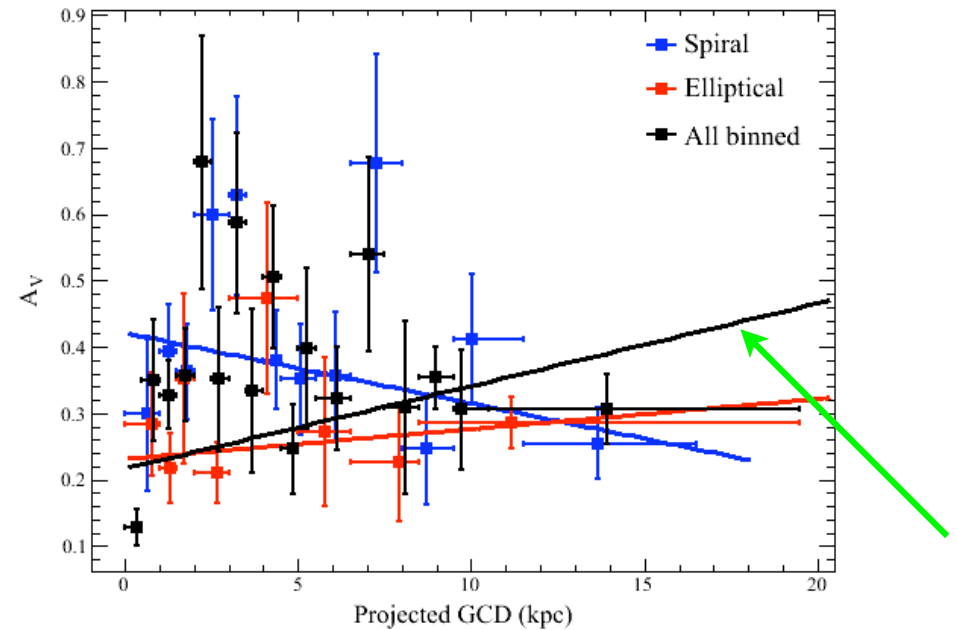
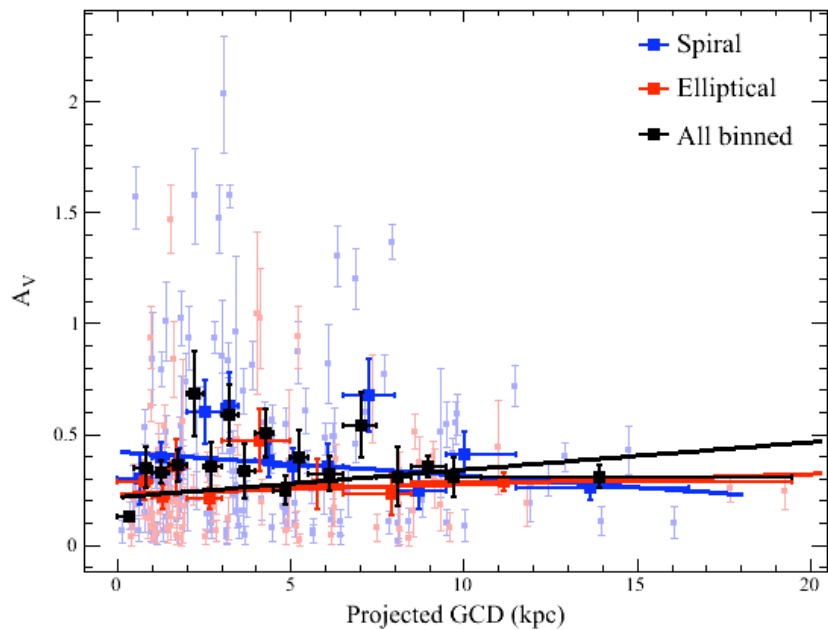
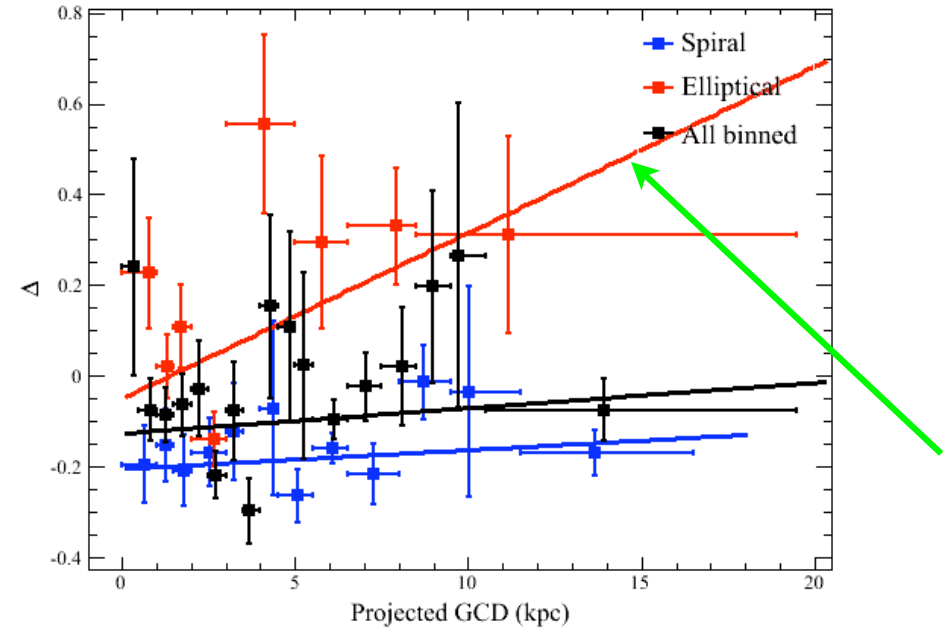
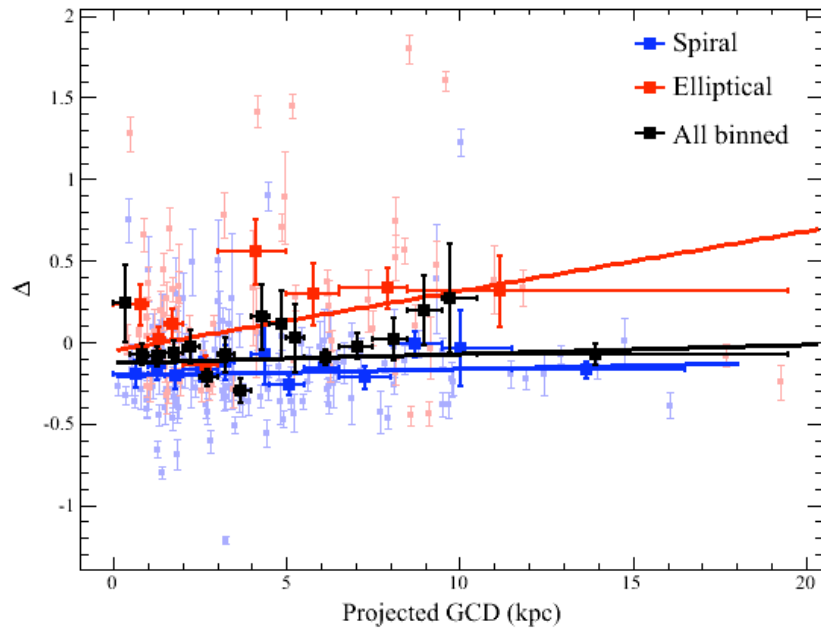
- A_V , Δ and Hubble residuals binned (at least 5 SNe) as a function of distance
- Linear fit of all the SNe and taking into account different host types

MLCS fit results

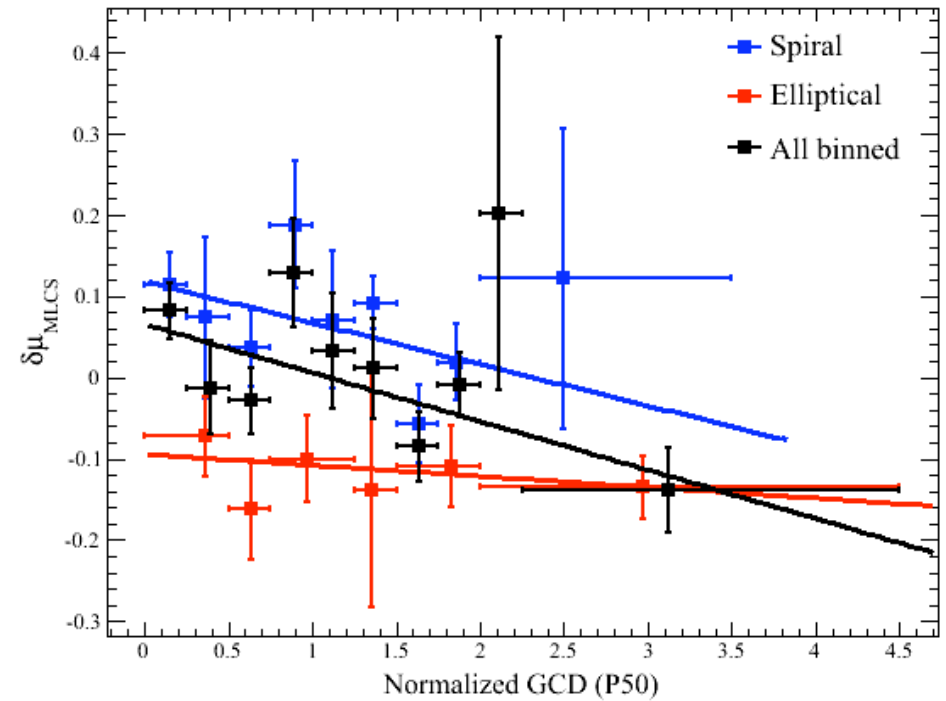
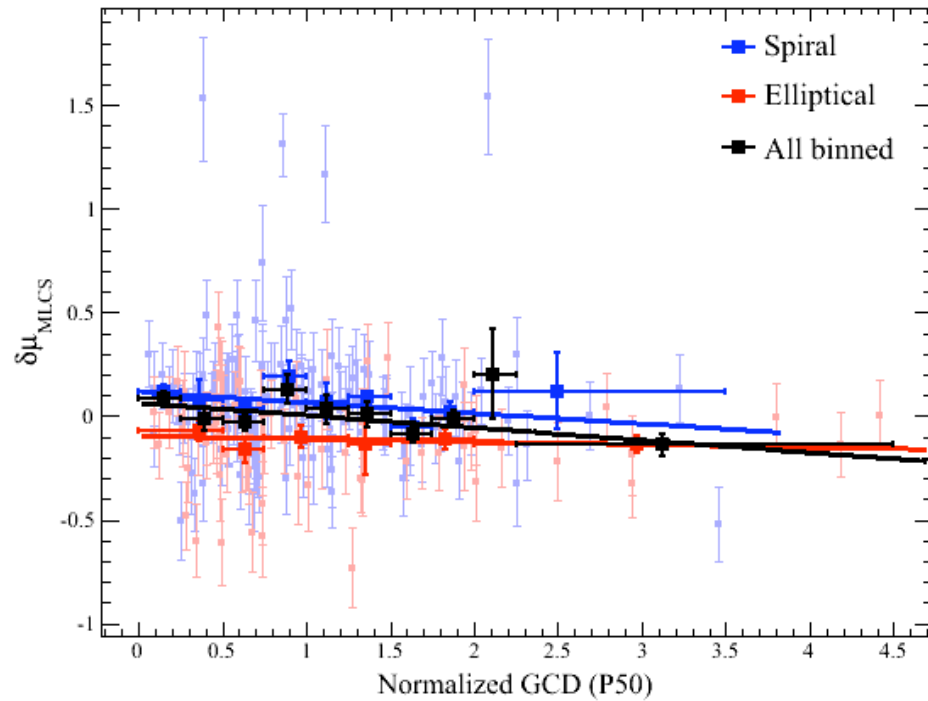
MLCS					
Parameter	Distance	Host type	Slope	σ	χ^2/Ndof
A_V	PGCD (kpc)	All	0.012 ± 0.004	3.47	43.954/15 = 2.930
		Spiral	-0.011 ± 0.005	1.99	12.249/11 = 1.114
		Elliptical	0.005 ± 0.005	0.87	4.489/6 = 0.748
	NGCD (P50)	All	0.030 ± 0.015	1.94	53.508/8 = 6.689
		Spiral	0.044 ± 0.023	1.95	36.926/7 = 5.275
		Elliptical	-0.031 ± 0.025	1.25	3.135/4 = 0.784
	NGCD (deV)	Elliptical	-0.001 ± 0.011	0.10	15.781/6 = 2.630
	NGCD (exp)	Spiral	0.006 ± 0.019	0.29	14.211/9 = 1.579
	Δ	PGCD (kpc)	All	0.006 ± 0.006	1.01
Spiral			0.004 ± 0.005	0.83	10.195/11 = 0.927
Elliptical			0.037 ± 0.015	2.39	21.554/6 = 3.592
NGCD (P50)		All	0.045 ± 0.039	1.16	5.791/8 = 0.724
		Spiral	0.004 ± 0.035	0.11	9.228/7 = 1.318
		Elliptical	0.092 ± 0.064	1.45	3.446/4 = 0.861
NGCD (deV)		Elliptical	0.054 ± 0.042	1.30	9.351/6 = 1.558
NGCD (exp)		Spiral	0.007 ± 0.022	0.31	15.776/9 = 1.753
$\delta\mu$		PGCD (kpc)	All	-0.008 ± 0.004	1.95
	Spiral		-0.006 ± 0.005	1.21	17.791/11 = 1.617
	Elliptical		-0.006 ± 0.006	1.00	10.837/6 = 1.806
	PGCD (P50)	All	-0.060 ± 0.018	3.33	10.908/8 = 1.364
		Spiral	-0.051 ± 0.028	1.79	9.508/7 = 1.358
		Elliptical	-0.014 ± 0.021	1.79	1.307/4 = 0.327
	NGCD (dev)	Elliptical	-0.008 ± 0.013	0.63	11.519/6 = 1.920
NGCD (exp)	Spiral	-0.019 ± 0.020	0.99	11.456/9 = 1.273	

- few slopes significantly different from zero
- no significant different slope from fits separating ellipticals and spirals

MLCS A_V & Δ (kpc)



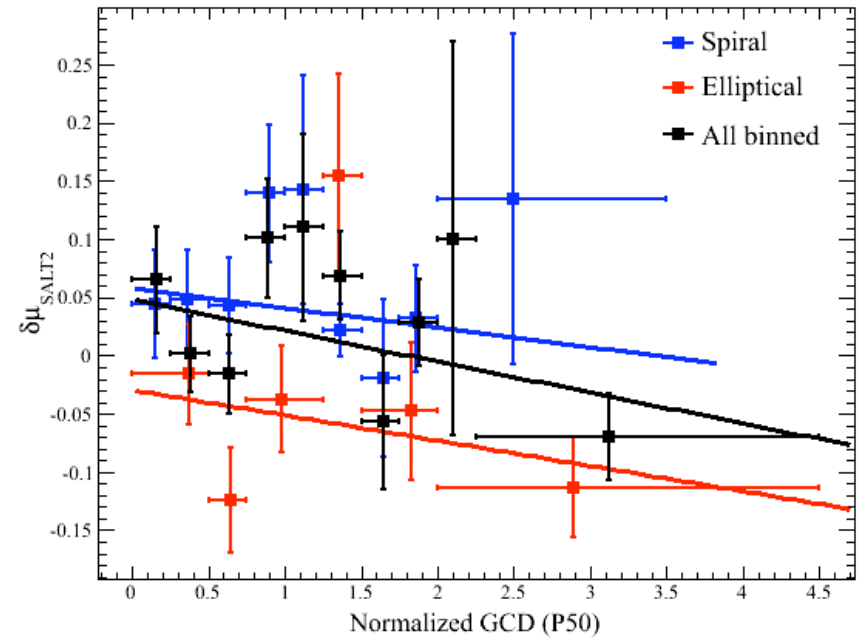
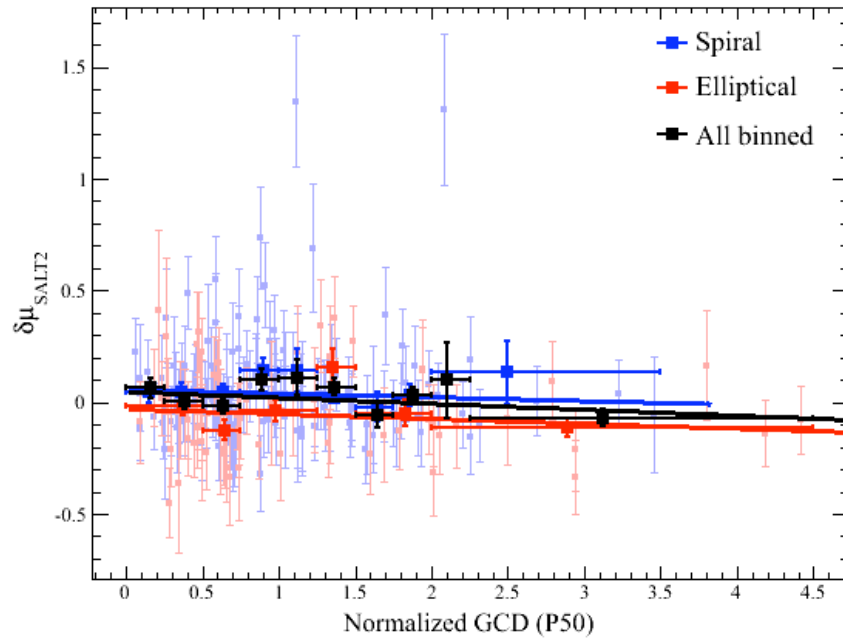
MLCS residual (P50)



SALT2 results

- similar trend on $\delta\mu$

SALT2					
Parameter	Distance	Host type	Slope	σ	χ^2/Ndof
c	PGCD (kpc)	All	-0.002 ± 0.002	0.84	$16.654/13 = 1.281$
		Spiral	-0.000 ± 0.004	0.07	$11.267/10 = 1.127$
		Elliptical	0.011 ± 0.005	2.34	$20.074/6 = 3.346$
	NGCD (P50)	All	-0.031 ± 0.015	2.07	$11.099/8 = 1.387$
		Spiral	-0.013 ± 0.019	0.66	$14.755/7 = 2.108$
		Elliptical	-0.001 ± 0.019	0.06	$3.196/4 = 0.799$
	NGCD (dev)	Elliptical	0.027 ± 0.013	2.01	$9.931/6 = 1.655$
NGCD (exp)	Spiral	0.005 ± 0.012	0.41	$7.406/7 = 1.058$	
x1	PGCD (kpc)	All	-0.006 ± 0.021	0.30	$15.999/13 = 1.231$
		Spiral	-0.026 ± 0.028	0.93	$13.019/10 = 1.302$
		Elliptical	-0.069 ± 0.041	1.70	$14.697/6 = 2.450$
	NGCD (P50)	All	-0.139 ± 0.115	1.21	$16.726/8 = 2.091$
		Spiral	-0.051 ± 0.128	0.40	$6.942/7 = 0.992$
		Elliptical	-0.270 ± 0.174	1.55	$2.526/4 = 0.631$
	NGCD (dev)	Elliptical	-0.129 ± 0.118	1.09	$3.354/6 = 0.559$
NGCD (exp)	Spiral	-0.078 ± 0.069	1.13	$13.794/7 = 1.971$	
$\delta\mu$	PGCD (kpc)	All	-0.002 ± 0.003	0.66	$26.002/13 = 2.000$
		Spiral	-0.002 ± 0.004	0.57	$14.102/10 = 1.410$
		Elliptical	-0.000 ± 0.006	0.00	$14.841/6 = 2.473$
	PGCD (P50)	All	-0.027 ± 0.015	1.78	$12.281/8 = 1.535$
		Spiral	-0.017 ± 0.026	0.64	$5.435/7 = 0.776$
		Elliptical	-0.022 ± 0.022	0.64	$9.930/4 = 2.482$
	NGCD (dev)	Elliptical	0.002 ± 0.015	0.14	$6.408/6 = 1.068$
NGCD (exp)	Spiral	-0.000 ± 0.010	0.01	$7.370/7 = 1.054$	



MLCS near-far binning

- 2 bins near/far:
- PGCD: 4kpc
- NGCD: 1 unit

Parameter	Distance	Host type	MLCS		Difference	σ
			Near	Far		
A_V	PGCD (kpc)	All	0.386 ± 0.037	0.359 ± 0.034	-0.027 ± 0.050	-0.54
		Elliptical	0.275 ± 0.045	0.314 ± 0.052	0.039 ± 0.069	0.57
		Spiral	0.447 ± 0.050	0.383 ± 0.043	-0.064 ± 0.066	-0.97
	NGCD (P50)	All	0.416 ± 0.037	0.313 ± 0.031	-0.103 ± 0.048	-2.13
		Elliptical	0.314 ± 0.049	0.254 ± 0.038	-0.060 ± 0.062	-0.96
		Spiral	0.475 ± 0.049	0.342 ± 0.043	-0.134 ± 0.065	-2.05
	NGCD (deV)	Elliptical	0.294 ± 0.058	0.290 ± 0.040	-0.004 ± 0.071	-0.05
	NGCD (exp)	Spiral	0.435 ± 0.067	0.411 ± 0.038	-0.024 ± 0.077	-0.31
Δ	PGCD (kpc)	All	-0.085 ± 0.033	0.039 ± 0.054	0.123 ± 0.063	1.96
		Elliptical	0.085 ± 0.054	0.375 ± 0.107	0.291 ± 0.120	2.42
		Spiral	-0.179 ± 0.036	-0.145 ± 0.041	0.033 ± 0.055	0.61
	NGCD (P50)	All	-0.068 ± 0.036	0.020 ± 0.051	0.088 ± 0.062	1.41
		Elliptical	0.133 ± 0.064	0.329 ± 0.106	0.196 ± 0.124	1.58
		Spiral	-0.186 ± 0.036	-0.134 ± 0.041	0.052 ± 0.055	0.94
	NGCD (deV)	Elliptical	0.151 ± 0.081	0.250 ± 0.080	0.099 ± 0.114	0.87
	NGCD (exp)	Spiral	-0.162 ± 0.043	-0.166 ± 0.035	-0.004 ± 0.055	-0.07
$\delta\mu$	PGCD (kpc)	All	0.019 ± 0.028	-0.005 ± 0.034	-0.024 ± 0.044	-0.55
		Elliptical	-0.103 ± 0.035	-0.128 ± 0.041	-0.024 ± 0.054	-0.45
		Spiral	0.091 ± 0.037	0.056 ± 0.044	-0.035 ± 0.057	-0.61
	NGCD (P50)	All	0.026 ± 0.028	-0.013 ± 0.034	-0.040 ± 0.044	-0.90
		Elliptical	-0.098 ± 0.035	-0.132 ± 0.041	-0.034 ± 0.054	-0.62
		Spiral	0.095 ± 0.037	0.052 ± 0.044	-0.044 ± 0.058	-0.76
	NGCD (deV)	Elliptical	-0.074 ± 0.044	-0.142 ± 0.033	-0.067 ± 0.054	-1.23
	NGCD (exp)	Spiral	0.102 ± 0.053	0.062 ± 0.032	-0.040 ± 0.062	-0.64

SALT2 near-far binning

- 2 bins near/far:
- PGCD: 4kpc
- NGCD: 1 unit

SALT2							
Parameter	Distance	Host type	Near	Far	Difference	σ	
c	PGCD (kpc)	All	0.076 ± 0.017	0.105 ± 0.020	0.030 ± 0.027	1.12	
		Elliptical	0.065 ± 0.030	0.137 ± 0.033	0.072 ± 0.045	1.61	
		Spiral	0.082 ± 0.022	0.088 ± 0.025	0.006 ± 0.033	0.18	
	NGCD (P50)	All	0.091 ± 0.018	0.086 ± 0.020	-0.005 ± 0.027	-0.21	
		Elliptical	0.087 ± 0.031	0.110 ± 0.032	0.023 ± 0.044	0.51	
		Spiral	0.094 ± 0.021	0.073 ± 0.025	-0.021 ± 0.033	-0.63	
NGCD (deV)	Elliptical	0.090 ± 0.040	0.101 ± 0.026	0.011 ± 0.048	0.23		
NGCD (exp)	Spiral	0.063 ± 0.026	0.096 ± 0.020	0.033 ± 0.033	0.99		
x1	PGCD (kpc)	All	-0.164 ± 0.116	-0.451 ± 0.149	-0.287 ± 0.188	-1.53	
		Elliptical	-0.593 ± 0.200	-1.191 ± 0.221	-0.598 ± 0.298	-2.01	
		Spiral	0.091 ± 0.131	-0.039 ± 0.171	-0.130 ± 0.216	-0.60	
	NGCD (P50)	All	-0.173 ± 0.114	-0.451 ± 0.153	-0.278 ± 0.191	-1.46	
		Elliptical	-0.615 ± 0.191	-1.203 ± 0.237	-0.588 ± 0.304	-1.93	
		Spiral	0.100 ± 0.130	-0.052 ± 0.173	-0.152 ± 0.217	-0.70	
	NGCD (deV)	Elliptical	-0.648 ± 0.236	-0.999 ± 0.196	-0.351 ± 0.307	-1.14	
	NGCD (exp)	Spiral	-0.077 ± 0.143	0.088 ± 0.141	0.165 ± 0.201	0.82	
	$\delta\mu$	PGCD (kpc)	All	0.022 ± 0.020	0.040 ± 0.030	0.018 ± 0.037	0.48
			Elliptical	-0.056 ± 0.030	-0.024 ± 0.037	0.032 ± 0.048	0.66
			Spiral	0.070 ± 0.025	0.073 ± 0.041	0.004 ± 0.049	0.07
		NGCD (P50)	All	0.018 ± 0.019	0.044 ± 0.031	0.026 ± 0.037	0.71
Elliptical			-0.062 ± 0.030	-0.017 ± 0.037	0.045 ± 0.048	0.95	
Spiral			0.066 ± 0.022	0.078 ± 0.043	0.012 ± 0.049	0.25	
NGCD (deV)	Elliptical	-0.040 ± 0.039	-0.045 ± 0.029	-0.005 ± 0.049	-0.11		
NGCD (exp)	Spiral	0.014 ± 0.027	0.100 ± 0.032	0.087 ± 0.041	2.10		

Summary

- No sign of significant slopes fitting the SN parameters as a function of the distance (except residuals vs P50)
- Not enough data to see differences taking into account the different host types
- With BOSS (SDSS-III) we are going to increase the number of spectroscopical hosts of photo-Ia [105].
- Things that we don't take into account: spiral arms, inclination ...

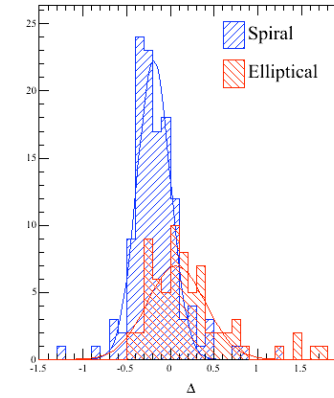
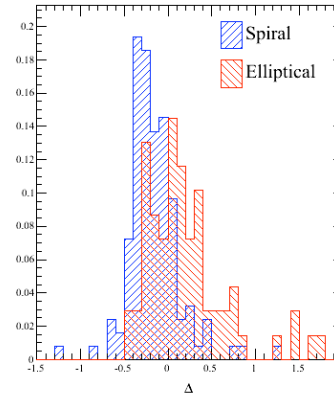
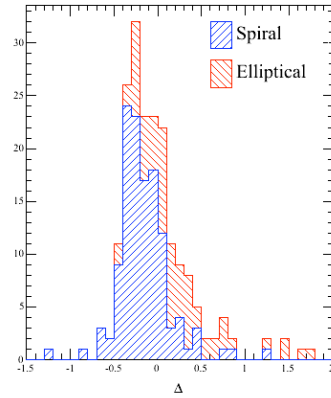
Plots

MLCS results

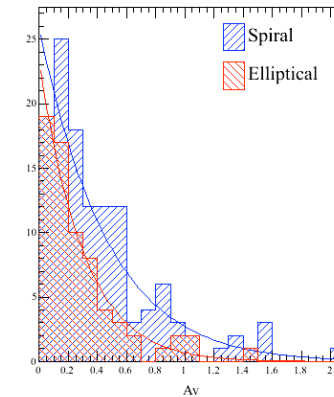
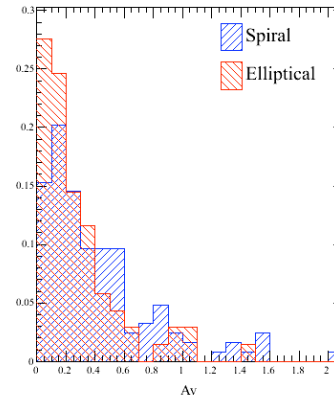
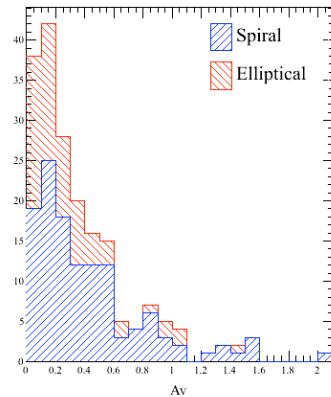
Stacked

Unit area

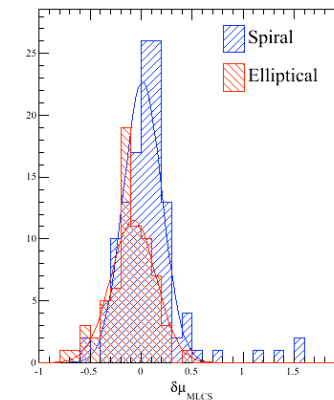
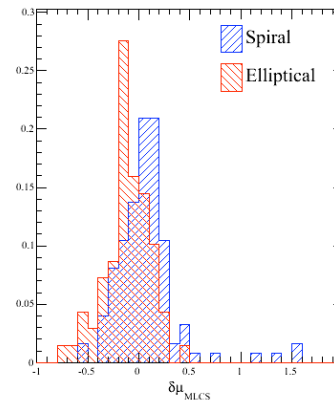
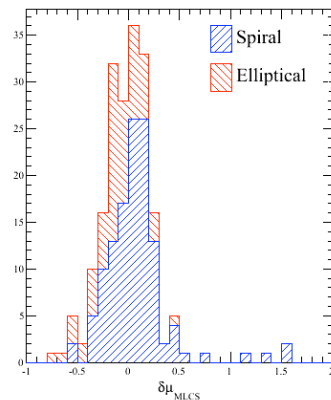
Absolute #



Δ

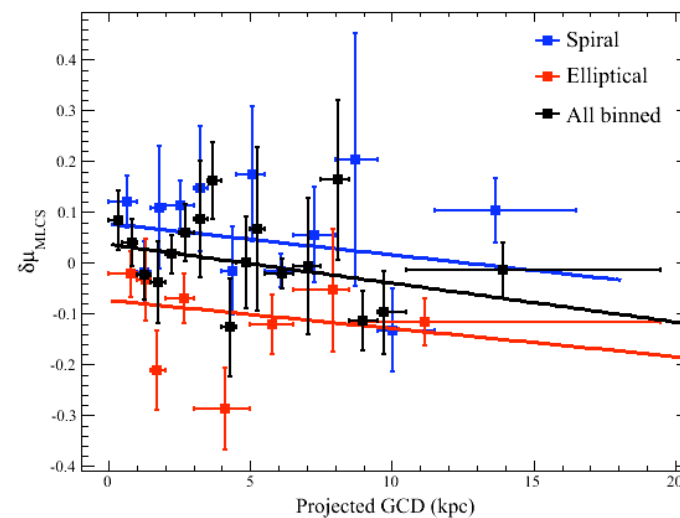
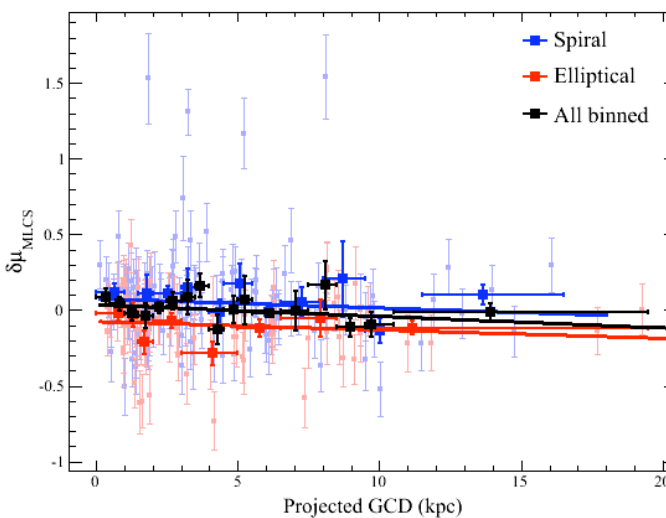
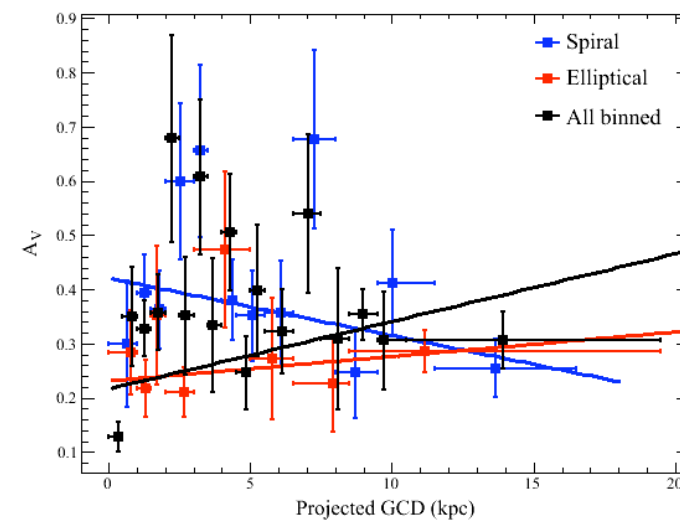
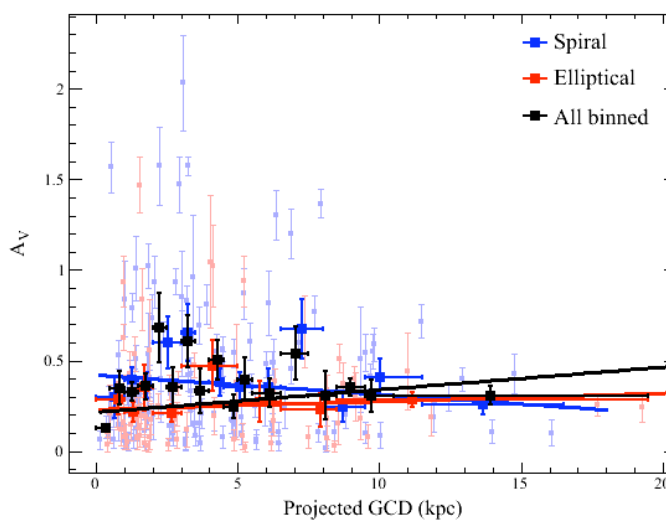
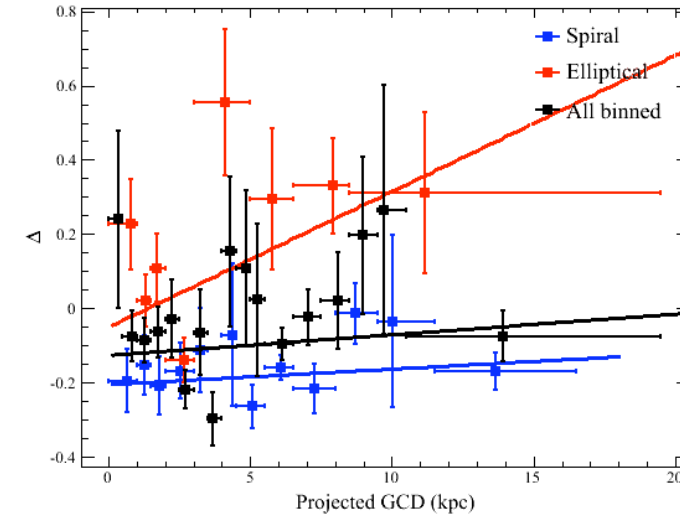
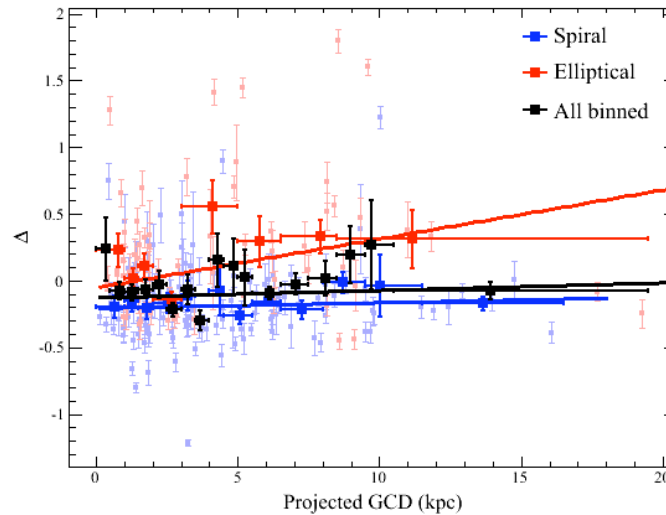


A_V

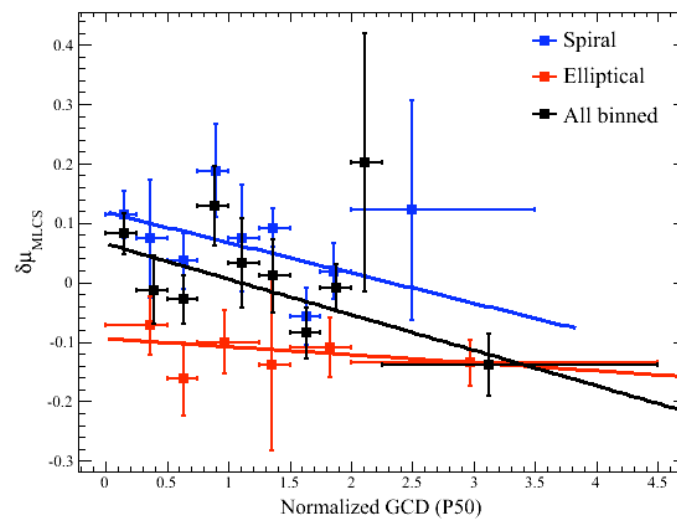
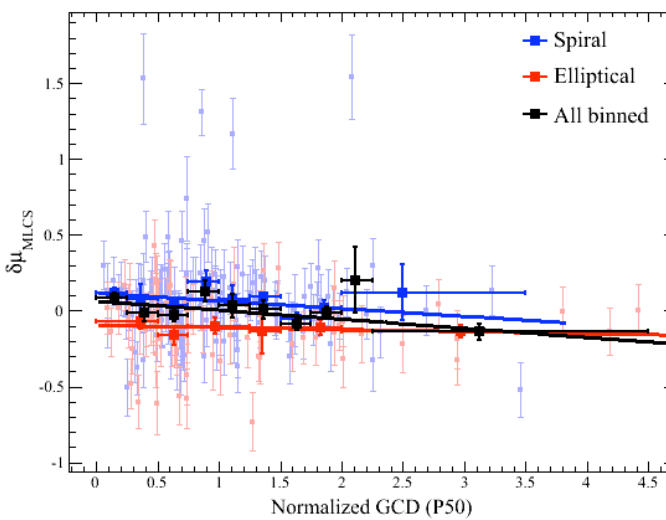
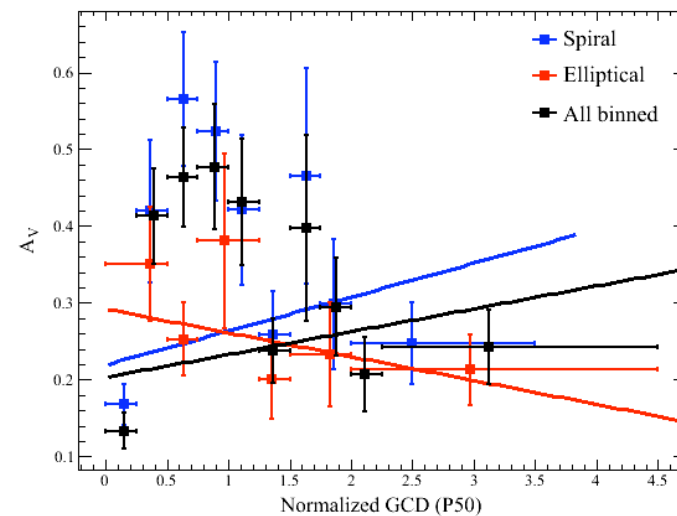
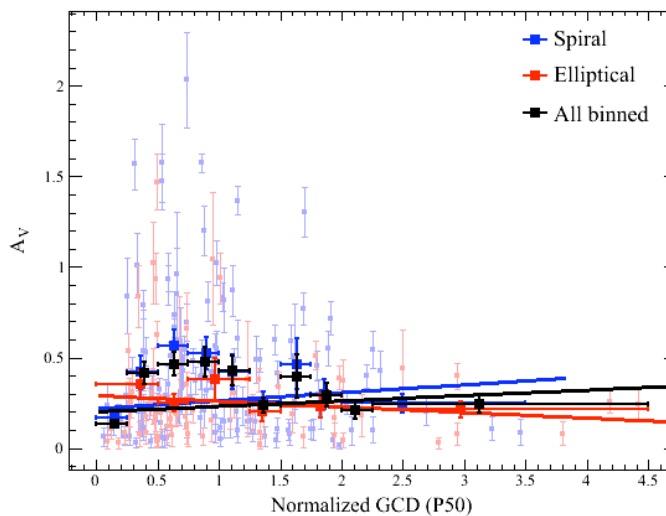
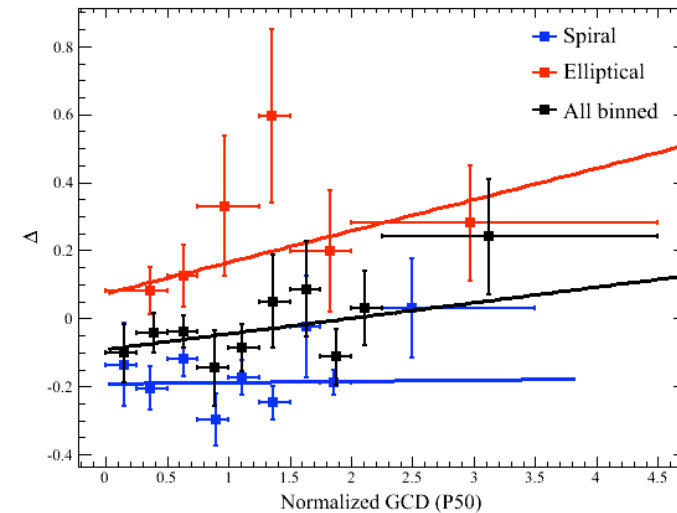
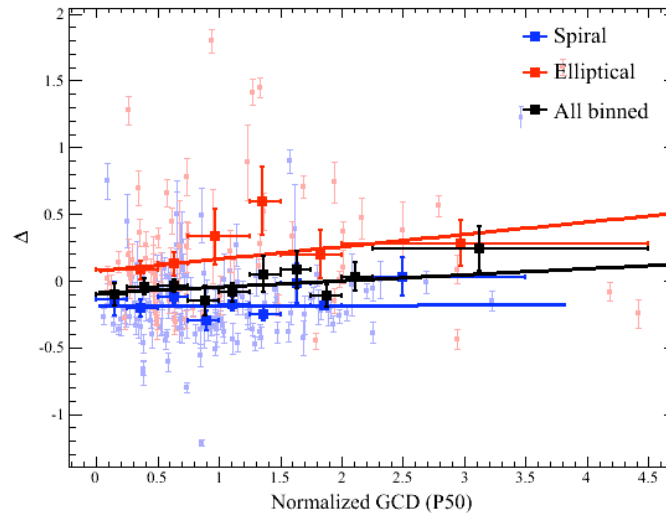


$\delta\mu$

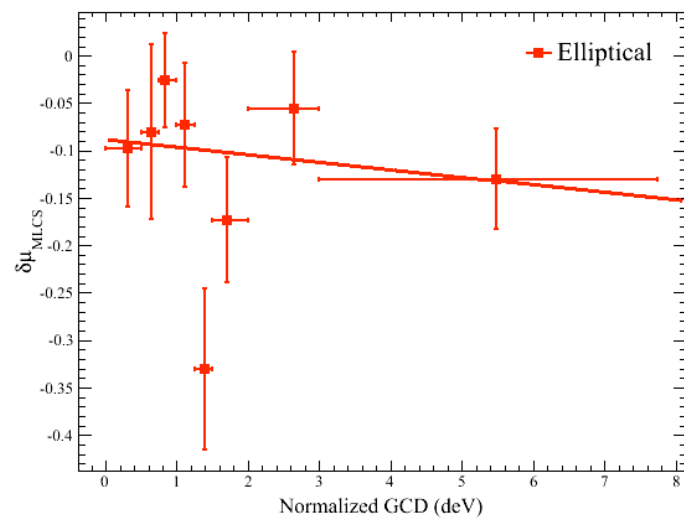
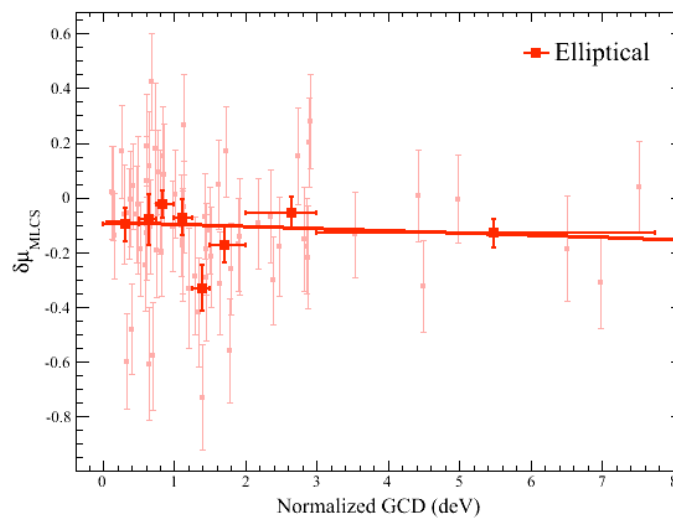
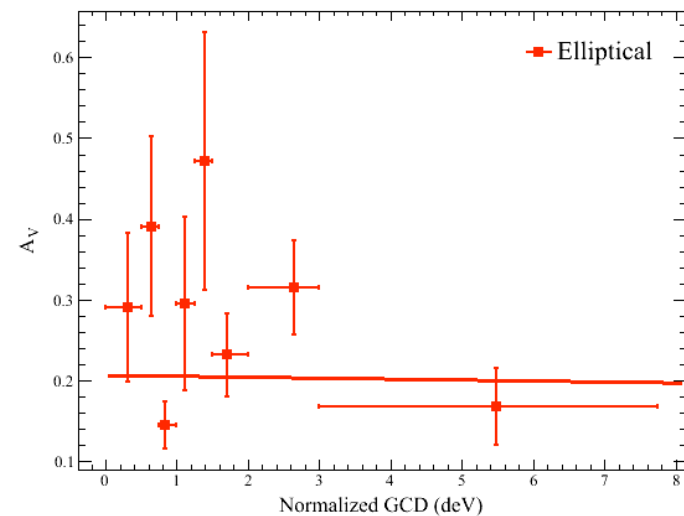
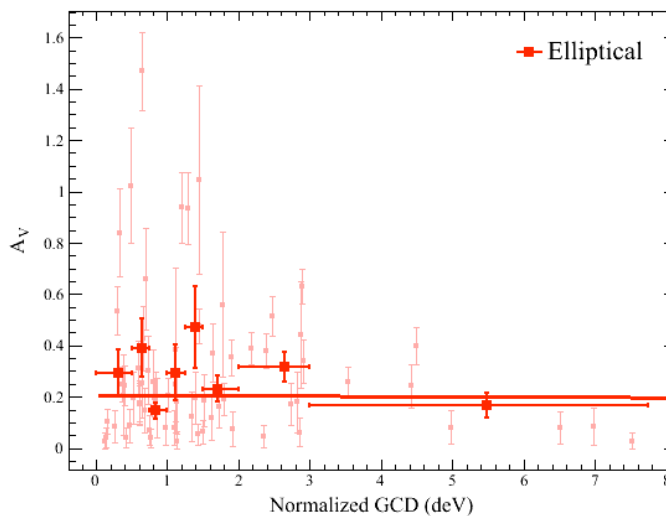
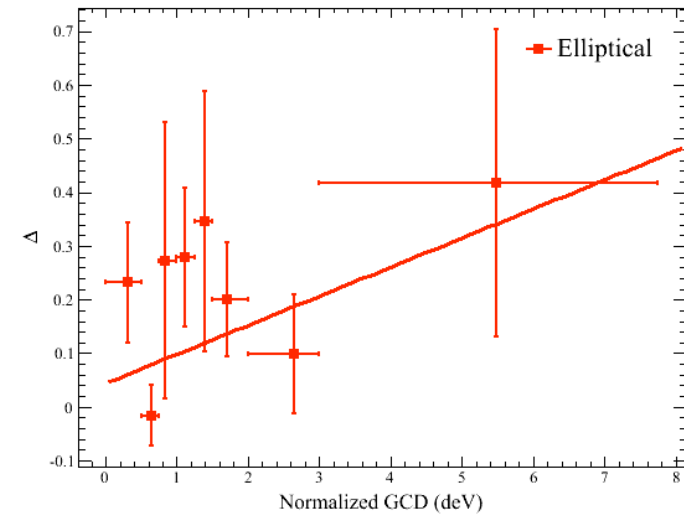
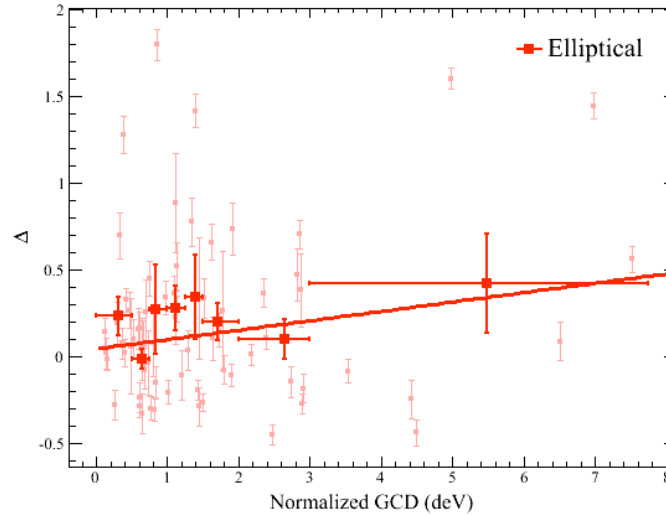
MLCS results (kpc)



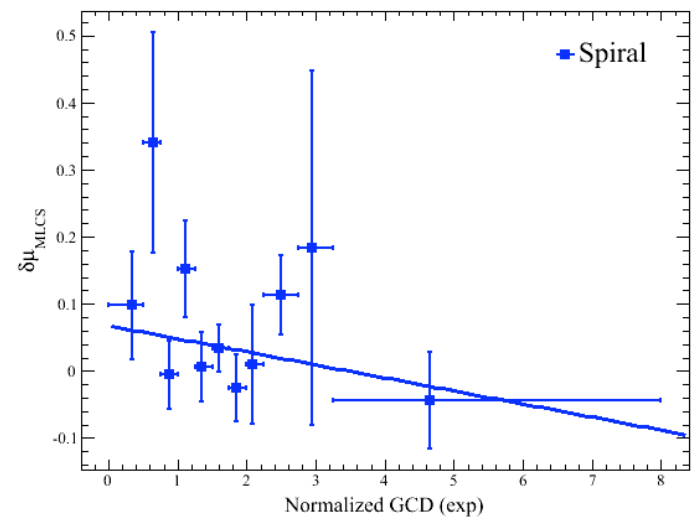
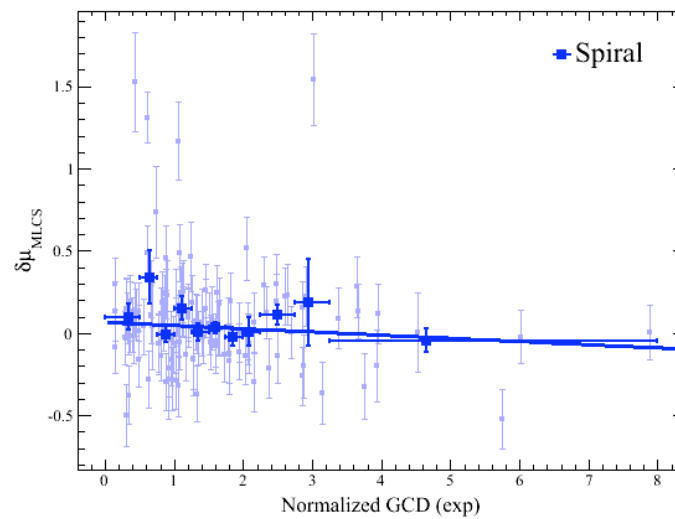
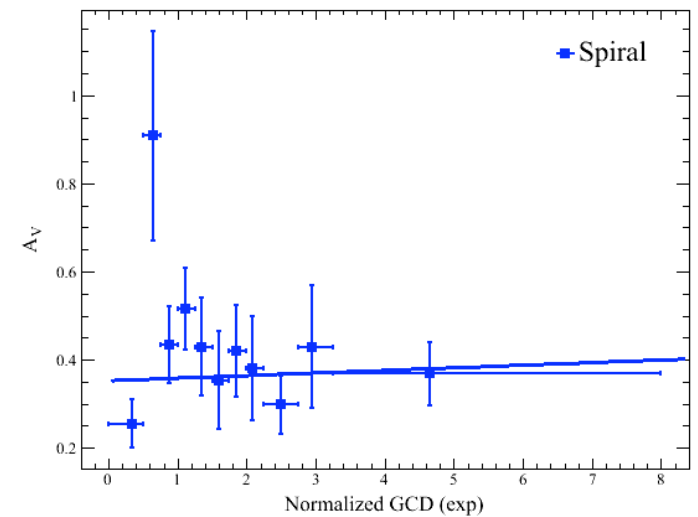
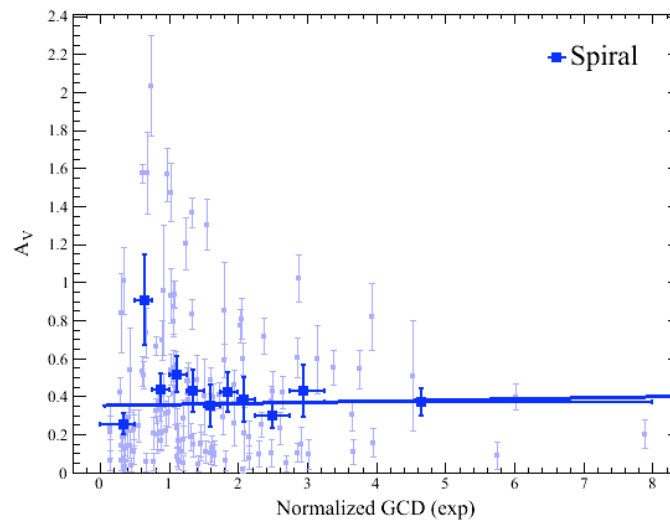
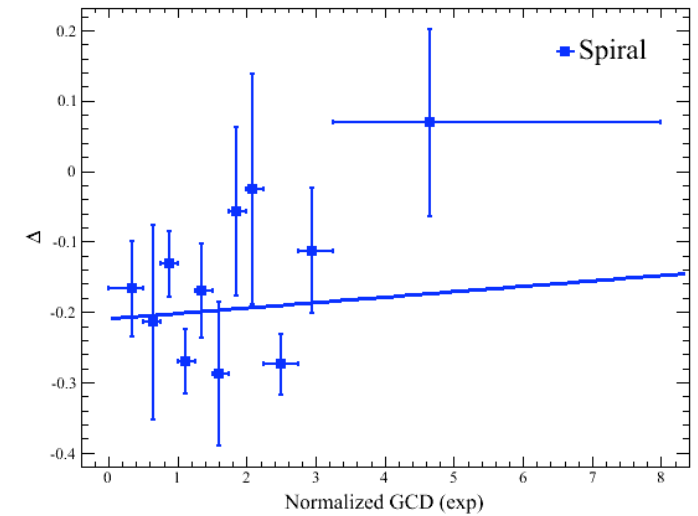
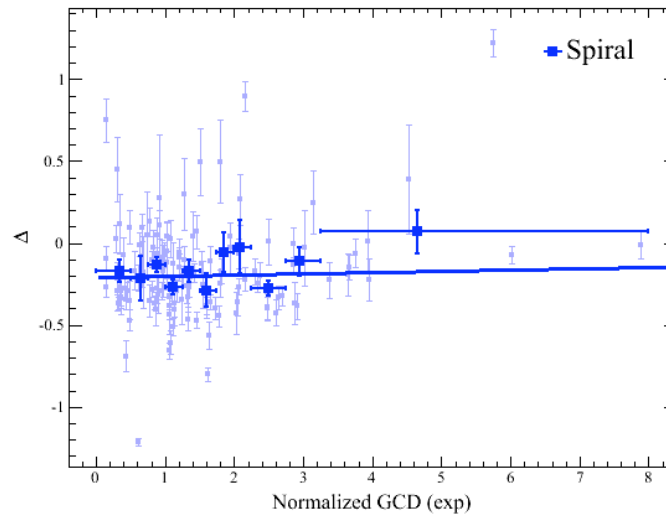
MLCS results (P50)



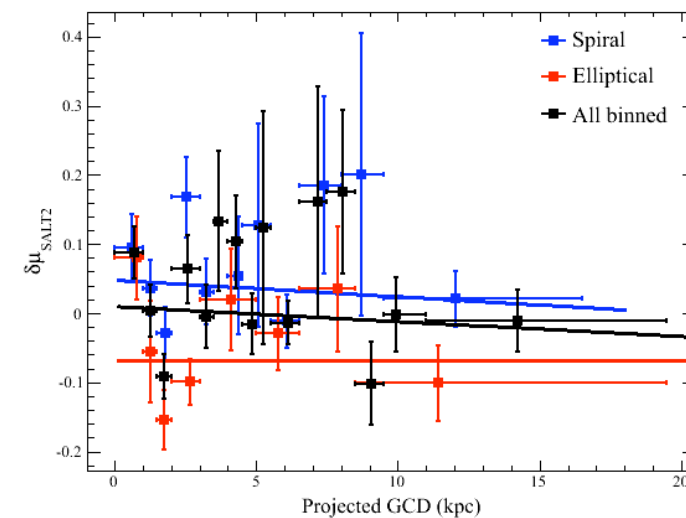
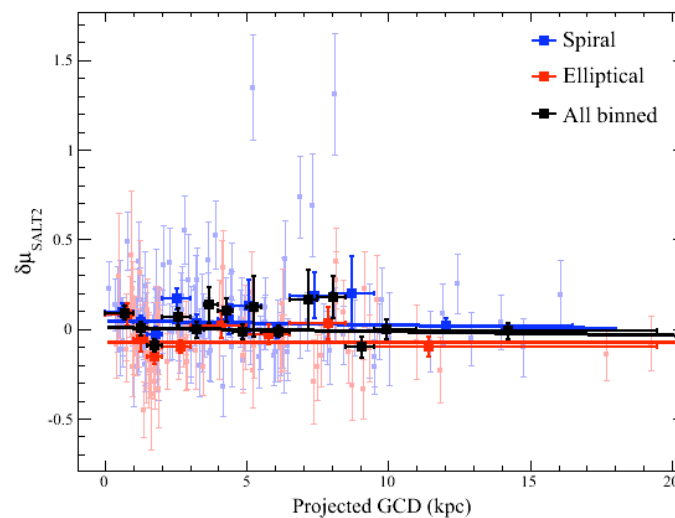
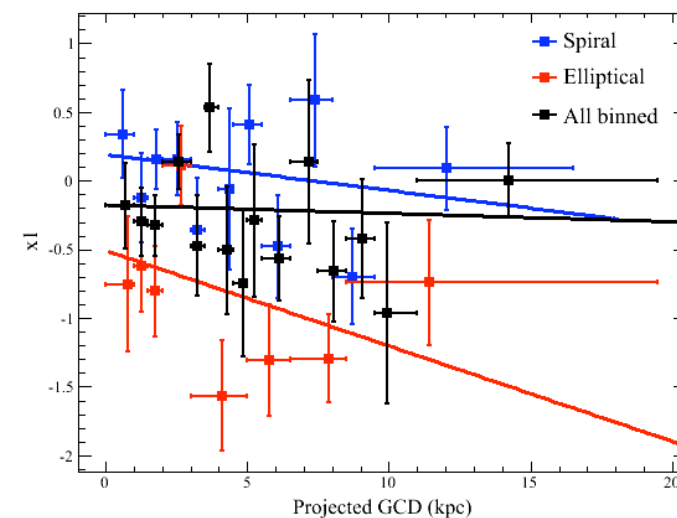
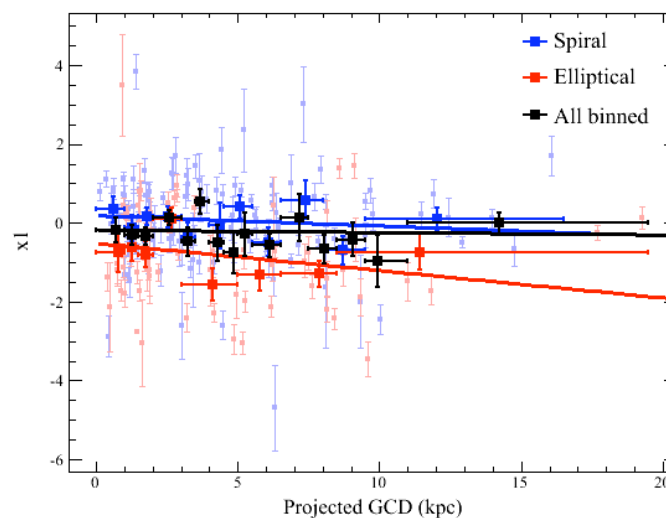
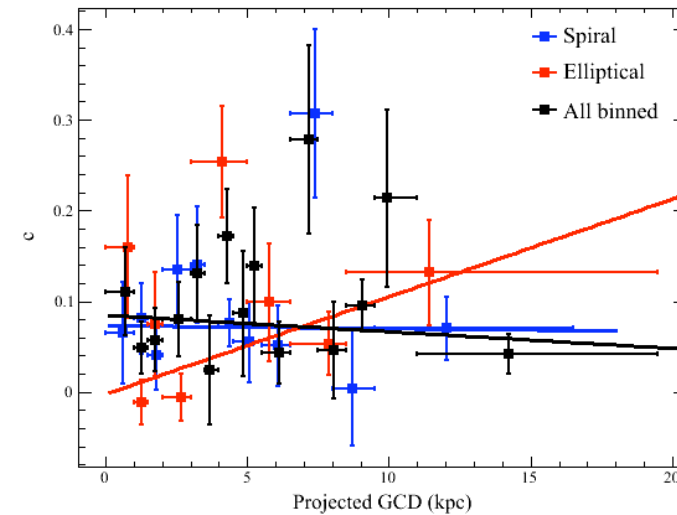
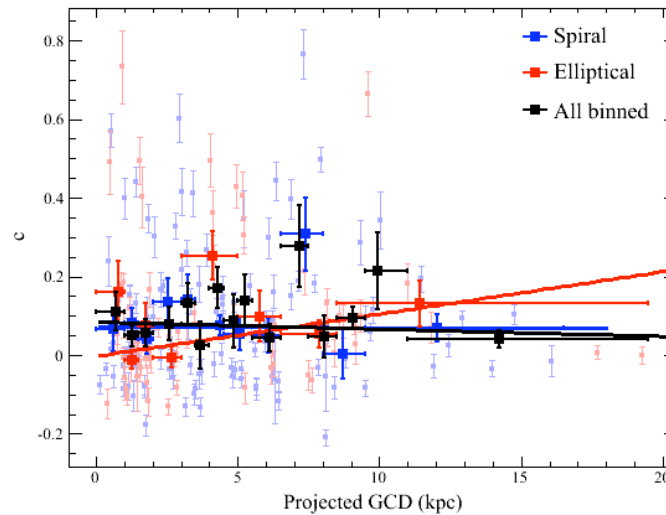
MLCS results (deV)



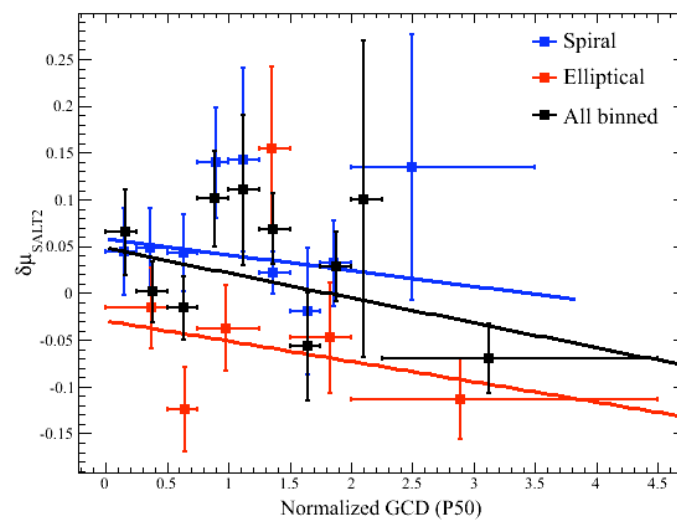
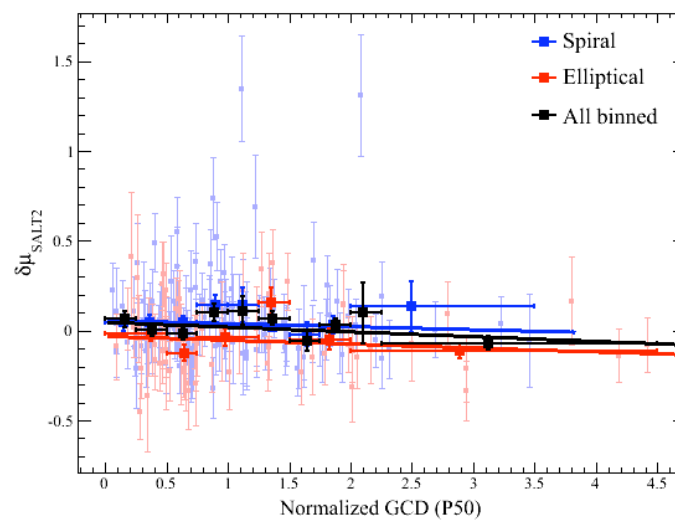
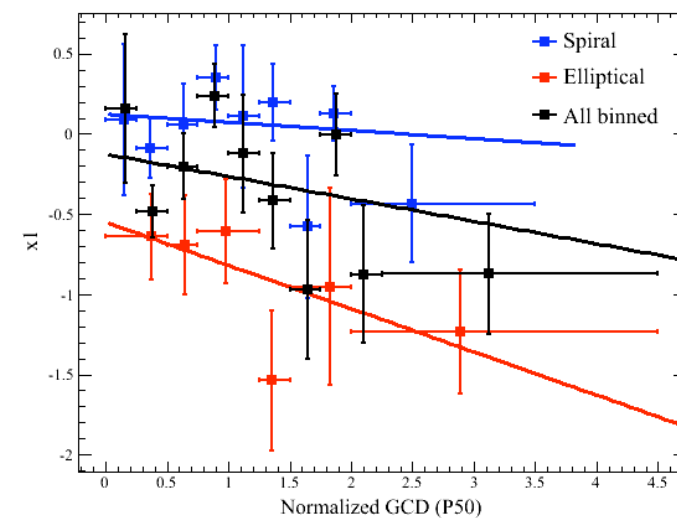
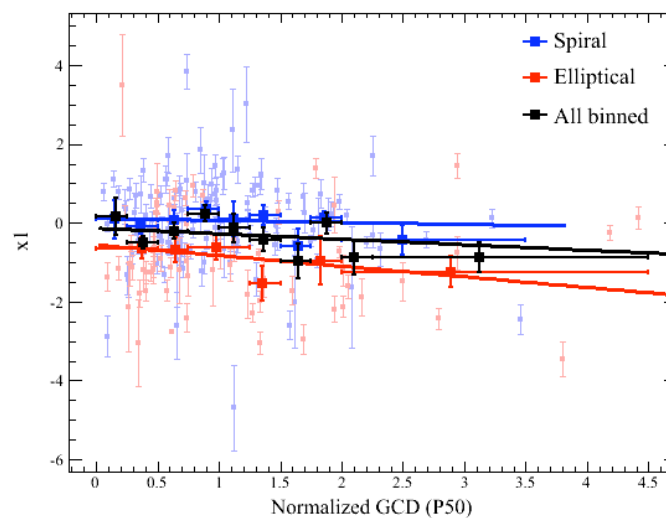
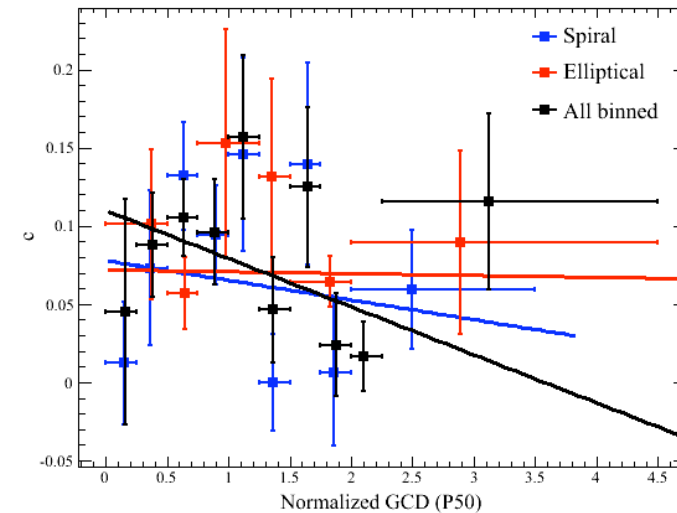
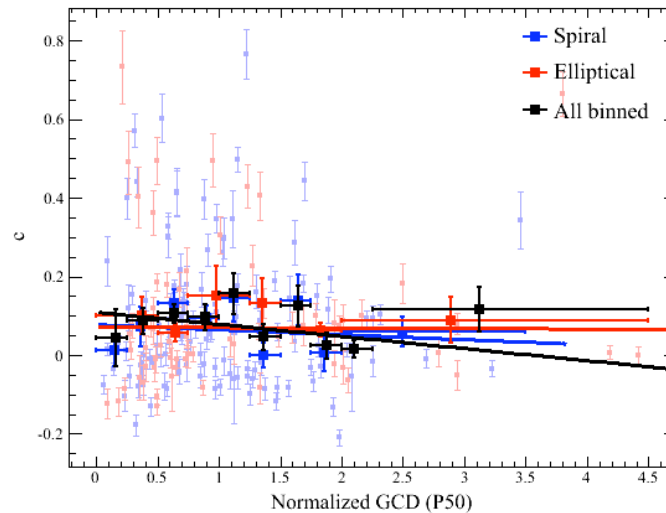
MLCS results (exp)



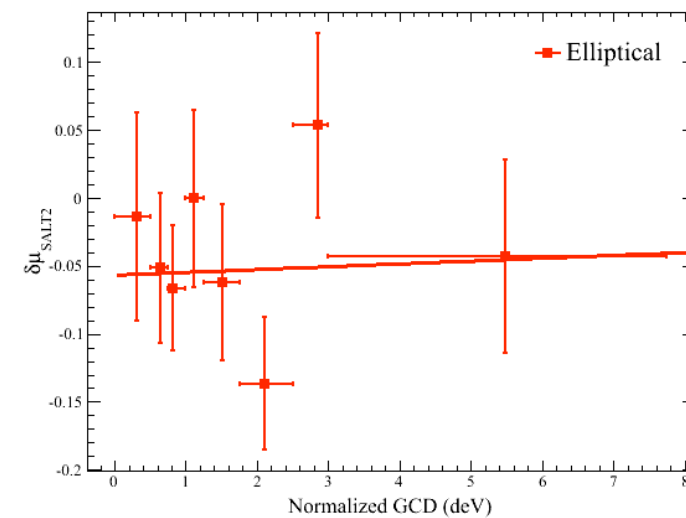
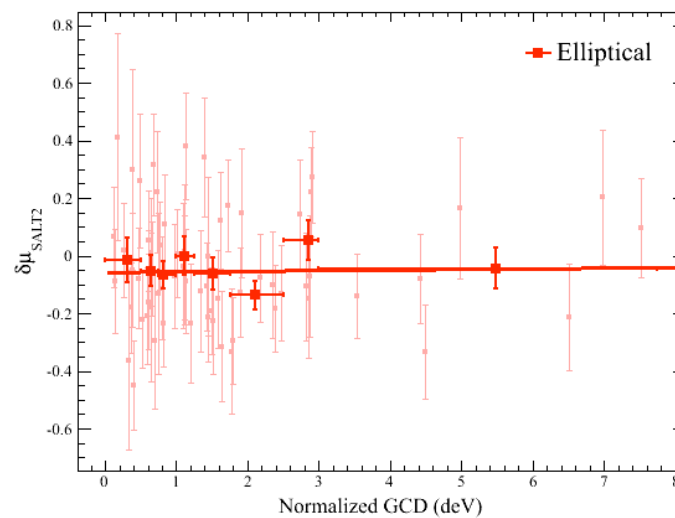
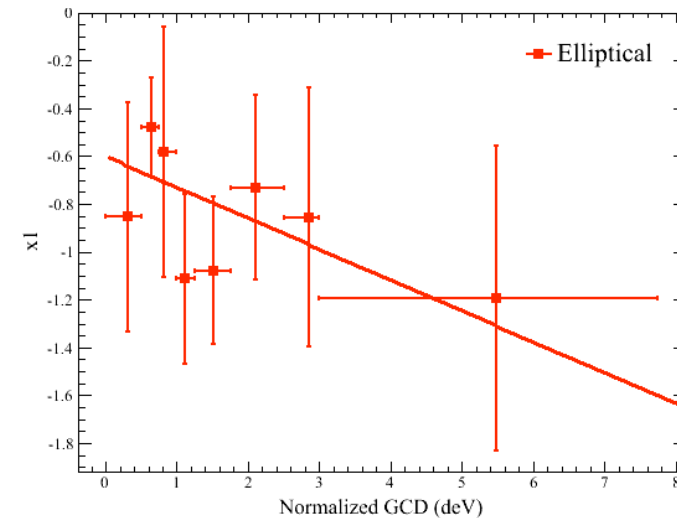
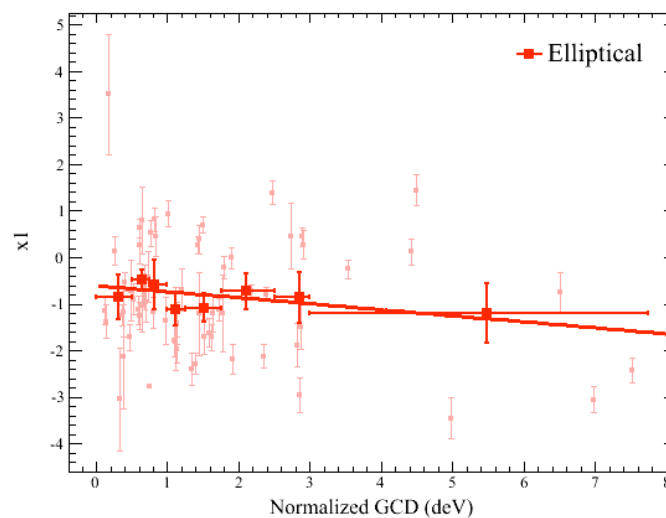
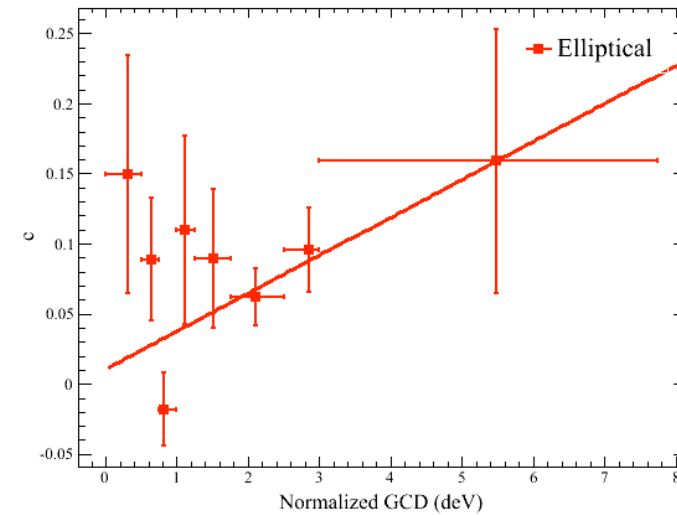
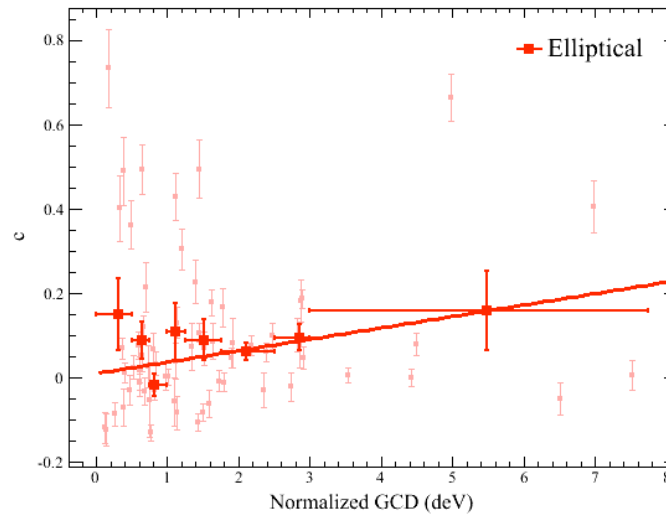
SALT2 results (kpc)



SALT2 results (P50)



SALT2 results (deV)



SALT2 results (exp)

